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INSTALLATION OF SHALLOW OBSERVATION WELLS

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The elevation of the permanent ground water table is known to fluctuate considerably. Water tables that lie less than 15 feet from the surface characteristically have frequent and extreme fluctuations. Rises of five feet or more after heavy rains are not uncommon. These fluctuations of the water table have a decided influence on soil moisture relations and are directly related to many practical problems of land use. On farm land the proximity of the water table frequently determines the kinds of crops that can be grown. It indicates the need for tile and ditch drains on level land. It is related to the location and construction of foundations for buildings. The following discussion applies to shallow wells specially installed to observe water tables lying less than 15 feet from the surface.

In the management and operation of municipal and industrial watersheds, water table "index wells" will indicate the shortage or abundance of ground water supplies. Also the position of the water table, together with the moisture content of the soil, govern the existing opportunity for water storage within the soil profile and consequently assist in predicting storm runoff, ground water yields, and periods of low streamflow.

The depth to the water table along the South Atlantic seaboard is a major factor controlling the ease of forest fire suppression in the pocosins and swamp lands. When the water table is low, fires burn deeply into the organic soil and deep plowing and other unusual methods are required to control the fire. Satisfactory mop-up is exceedingly difficult as the fire may smolder deeply in the ground and break out again in a few days.

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Observations of the relative height of exposed water surfaces in ponds and streams have been useful in the past to estimate the elevation of the water table. However, the use of shallow wells for this purpose may prove to be both more efficient and convenient. To assist in the solution of local problems relating to soil moisture and ground water, the following suggestions are presented. They are based on experience gained in the construction and operation of shallow wells installed on small drainage areas in the Southern Appalachians to obtain measurements of ground water storage.

LOCATION. The selection of the best location for a shallow observation well depends on the purpose of the observations as well as local topography and ground water conditions. In level country with generally high water tables the problem of well location is comparatively simple. The well should generally be placed to represent average conditions on the study area. For example, wells to be used in estimates of forest fire burning conditions should be located in the forest types to which they are to apply. It must be remembered that in wells near river banks the water level may be controlled by the river stage and thus not be representative of any large area. In mountainous country it has been found that the wells most closely relating to ground water flow of streams are usually on the lower slopes just above the valley bottoms. More than one well ordinarily is needed to indicate ground water conditions over a watershed. Local conditions vary widely and a definite statement applicable everywhere cannot be made. However wells are inexpensive to construct and observation and experience will soon show which locations are most desirable.

USE OF ABANDONED FARM WELLS. Abandoned farm wells are occasionally used but they do not always represent a true water table for the locality. They are ordinarily dug to a considerable depth and may pass through impervious rock strata. In level sandy country they have been satisfactory, but in general domestic wells are less desirable for taking measurements of the water table than specially located observation wells.

SIZE. The size of the well depends upon the method of digging used and whether it is desired to install a continuous water level recorder. If a recorder is to be installed, 6 inches is the minimum diameter of the casing, and 12 inches is better. When no recorder is to be used the size of the well may be as small as 2 inches in diameter.

DIGGING. For smaller diameter wells, a soil auger or post hole auger may be used. Using a soil auger, prospect wells may be installed rapidly where the soil is not rocky. If it is desired to use such wells

permanently, they can be cased with two-inch galvanized pipe. The pipe is driven just behind the auger. The pipe should first be perforated by drilling 1/8 inch holes throughout its entire length. When saturated material is encountered, the auger will not lift it but this material can be removed by using a bailer made of 1-1/2 inch pipe with a foot-valve at the bottom which allows material to enter but prevents its escape.

Generally it is no problem to install small size wells that can be dug with ordinary tools from the surface. In some locations however, the soil is so rocky that it is necessary to resort to regular hand digging methods used for domestic wells. In this case usual safety precautions must be taken to prevent earth collapse or injury to laborers from falling debris.

During drought periods many shallow wells become dry. For this reason and for convenience in digging, it is best to put down wells during seasons of low water table in order to observe the maximum water table fluctuation for the locality.

CASING. Wells are cased to prevent their being filled with material from the sides of the hole. Where rock is available, a hand-dug well may be lined with masonry. Culvert pipes make a very satisfactory casing after they are perforated throughout their length. Wooden casings of rough lumber have also been used, leaving small spaces between boards to allow water to enter freely. If 2-inch stock is used and the wood is durable such as black locust or "fat" pine, wooden casings will give good service for several years. For wells 6 to 8 inches in diameter an inexpensive casing may be made of perforated galvanized metal stove pipe. The perforations may be punched in the sheet metal before rolling.

HOUSING. A cover is desirable to prevent rodents and debris from getting into the casing. Where an automatic recorder is not used, any type of simple strong lid may be used. If a continuous recorder is to be used, it must be protected from the weather by a suitable house. For permanency, it has been found best to pour a concrete well curb and bolt the house to this slab. The dimensions of the house should be chosen to suit the particular instrument used.

MEASUREMENTS. The simplest way of reading the depth to the water table is to measure from the ground surface down to the top of the water level. This is done by means of a measuring stick, or steel tape, lowered vertically into the well and read across a reference point such as a rigid iron bar bolted to the well casing. The

graduated stick may be used in reading shallow wells of small diameter, but a steel tape is more satisfactory and much more easily carried. In using the tape, the end is weighted and a few feet of the end of the tape coated with blue carpenter's chalk before it is lowered. The depth of the immersion is shown by the wetted end of the chalked tape, and the depth of the water table is a reading at the reference bar minus the wetted length of the tape.

When wells are large enough in diameter so that the water surface is visible, it is possible to make readings by lowering a plumb bob attached to the tape until it just touches the water surface. The dimple made by the end of the bob is easily visible if the water surface is quiet. The bob should not be over one inch in diameter with a gradually tapering but blunted point (vertex angle 120°). Such a bob may easily be made from a small piece of brass rod. Special boxes have been designed for holding and unreeling the tape as the reading is made. Also, simple electrical devices have been developed that indicate when contact with the water surface is made. These are found to be convenient but are not imperative. A continuous record of water table elevation may be obtained by the use of a water level recorder. Instruments which have an unlimited range of head are particularly suitable to measure the wide range of fluctuations of shallow water tables. These can be obtained for about seventy dollars.

Shallow water tables are likely to show daily fluctuation due to evaporation and transpiration. Consequently, readings should be made at approximately the same time each day. A reading at 7 or 8 A.M. will help eliminate the effect of fluctuation as the daily change seldom begins before this hour. Where daily readings are taken, the record should be kept on a permanent form for comparison of seasonal changes. The continuous plotted record of daily readings is helpful in following seasonal trends or changes in response to rainfall. A sample form is attached.

The Appalachian Forest Experiment Station, Asheville, North Carolina has had considerable experience in the operation of shallow observation wells, and on request will answer specific questions relating to water level recorders, housing designs, etc.

(Sample form for recording measurements)

WATER TABLE ELEVATIONS

Reference Iron Elevation*_____ Well Number_____
Well diameter_____Dug depth_____ Period_____19___to_____19_____
Date Installed_____ Location_____

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
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31												
Mean												

Remarks:_____

Maximum for Period_____Minimum for Period_____Maximum Range_____
Observer:_____

*The reference point may be established at the ground surface and considered to be 0'. The daily reading is then recorded as feet measured down to the water table. Where several wells are to be studied together it is better to determine the absolute elevation above mean sea level for each reference bar. In this case absolute elevations of the water table may be recorded by subtracting the daily measurement in feet from the elevation of the reference bar. The United States Geological Survey also uses a method of establishing an arbitrary datum point below the minimum level of each well, which may be tied into elevation above mean sea level. Readings are given in feet above the datum point.